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Observations of waterbirds on migration along two rivers in northern China during August 2010

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Introduction

The East Asian–Australasian Flyway (EAAF) is a huge region with little information on the status of its waterbirds, despite holding significant wader populations (Amano *et al.* 2010). The number of people in this region amounts to over 45% of the global population and it is changing very quickly because of its rapidly growing economies. Over 80% of the wetlands in East and South-East Asia are now classified as threatened, with over half of them under serious threat (International Wader Study Group 2003). Our knowledge of the flyway and the important places for migratory waders in China is limited to coastal zones, estuaries and river deltas (Wilson & Barter 1998, Ge *et al.* 2006, Zou *et al.* 2006, Jing *et al.* 2007). However, river valleys also serve as migration corridors for many bird species, especially waterbirds (Berthold 2001). The most important habitats for concentrating migrating waterbirds are natural riverbeds (Shields *et al.* 2000, Platteeuw *et al.* 2010) where they can find attractive places to rest and feed, such as sandy islands, sandbanks and muddy banks. Both the Huang He and Sungari rivers in northern China (Figure 1) have such habitats.

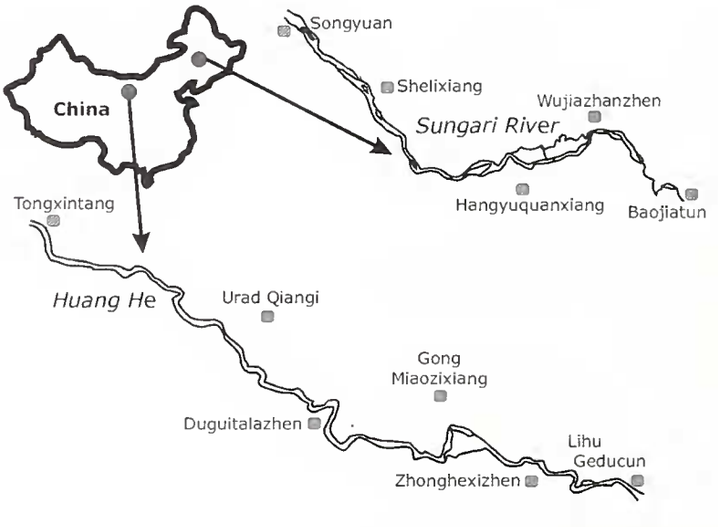
To date, published papers have described only rudimentary information about autumn migration in this area (e.g. Pronkevich 1998, He *et al.* 2010). The main goal of our work was a comparison of the avifauna of the two rivers, observed over several days during the peak autumn waterbird migration. Both are within the EAAF and we collected important data about some of the species which use this migration route. It is well known that the Huang He delta is very important for migrating birds, with up to 250,000 shorebirds congregating there during the northward migration period (Zhu *et al.* 2001), and the nearby area of Tanggu, on the coast of the Yellow Sea, is also important for many wader species (Barter *et al.* 2001). However, no data have been published about species composition or the numbers of waterbirds migrating in the middle reaches of the rivers in question. This work therefore makes a contribution to the knowledge of the migration of waterbirds in two regions of China.

In the second half of August 2010, we canoed the middle reaches of the Huang He and Sungari and counted waterbirds on or near them. The courses of the rivers are approximately parallel, with a distance of about 1,600 km between the two sampled stretches (Figure 1). Although the period of observation was short, it occurred during the peak of autumn migration, thereby allowing potentially important insights into the value of the river systems for certain migratory waterbirds in the EAAF.

Study area

Observations of waterbirds on autumn migration were conducted in the middle reaches of the Huang He along a 143 km section between Tongxintang (40.483°N 108.317°E) and Lihu Geducun (40.500°N 109.317°E) in Inner Mongolia. The largest city in the vicinity is Batou, 100 km to the east of Lihu Geducun (Figure 1). In this section, the river flows mainly through agricultural areas, which extend as a narrow strip along the valley where maize and sunflowers are cultivated, but the desert part of the Ordos Upland stretches for 40 km on the south bank. In some places, the desert

Figure 1. Map of the study area, showing the stretches of river covered and their positions in China.



reaches the banks of the river but, for most of the distance, hedgerows or villages separate it from the river. Many shallow places, sandbanks and islands, overgrown in various ways by soft-stemmed plants and shrubs, were observed on this part of the river where the main riverbed was usually 350"500 m wide.

The 126 km stretch of the Sungari which we observed was also in its middle reaches, between Baojiatun (44.800°N 125.867°E) and Songyuan (45.133°N 124.850°E) in Jilin province. The valley is used for agriculture, with maize cultivation dominating the fields and poplar plantations established in many places on islands and riverbanks. The Sungari also has many shallow places, sandbanks and sandy islands, but fewer than the Huang He, with the shallows concentrated in the lower part of the study area. As the result of floods which hit this area in the spring and summer of 2010, the main course of the river reached widths of 700–900 m and the backwaters embraced areas as wide as 1,500 m. Despite high water levels on both rivers, many attractive places for resting and feeding for birds were found.

Methods

Autumn bird migration in eastern Asia spans about four months, starting in July and finishing in October. Our observations were conducted during just a few days on each river but they were timed so as to include the migration peak of many waterbirds (Pronkevich 1998) and the numbers of birds recorded were relatively high.

Observations on the Sungari were made from 13–18 August 2010 and on the Huang He from 22–26 August 2010. We canoed in the main stream of the rivers and then paddled closer to groups of birds. Special attention was paid to shallows and sandbars, where birds were concentrated. All waterbirds were noted on maps, making a distinction between flocks and single birds. To avoid recording birds more than once, their movements were noted as precisely as possible. The birds were less disturbed by the sight of canoes than by observers moving on land, thus in our opinion the risk of counting the same birds more than once was minimised.

Data analysis

For comparisons of both the numbers of species and of birds, both stretches of river were divided into five sections, based on the distance travelled each day. A short section (2 km) of the Sungari covered on the evening of 13 August was included in the following day's figures. The mean daily section length for the Huang He was 28.6 km (s.d. 7.88) and for the Sungari 25.2 km (s.d. 4.32) and there were no significant differences (Mann-Whitney test, $z = 0.52$, $p = 0.602$, $n = 10$). The number of species and of birds on both rivers were compared using Mann-Whitney tests. Wilcoxon tests were used to compare the differences in the density of birds (defined as the number of individuals per 10 km) and flock sizes of particular species on both rivers. The calculations were performed using Statistica 8.0 (StatSoft 2007). Additionally, to calculate the similarity of species composition between the different river sections we used Jaccard's index, $j = c/a+b+c \times 100\%$, where c is the number of species common to both communities, a is the number of species in community A, and b the number of species in community B (Real & Vargas 1996). Comparisons of species densities employed the quantitative Sørensen's coefficient of similarity: $Sør = 2j/(a + b)$ where a and b are the total species density in both rivers and j is the sum of minimum values of densities of species common to both communities (Jankowski *et al.* 2009).

Results

On the Huang He, 6,270 birds (438.4/10 km) of 54 waterbird species were noted, and on the Sungari 1,767 birds (140.2/10 km) of 36 species (Table 1). Out of a total of 70 different species on both rivers, 34 species were observed only on the Huang He Heand 16 only on the Sungari, while 20 species were common to both. The average number of species on the sections on the Huang He was 29.2 (s.d. 6.57) and on the Sungari 19.6 (s.d. 1.52); differences between the rivers were significant (Mann-Whitney test, $z = 2.40$, $p = 0.016$, $n = 10$). Species similarity (Jaccard's index) between the rivers amounted to 22.2%, a relatively low value. The most numerous species on the Huang He were Mallard *Anas platyrhynchos*, Black-headed Gull *Larus ridibundus*, Common Tern *Sterna hirundo* and Eurasian Spoonbill *Platalea leucorodia*. On the Sungari, White-winged Terns *Chlidonias leucopterus* dominated, comprising almost 60% of all observed birds and only one other species, Whiskered Tern *C. hybrida*, exceeded a threshold of 5% (Table 1). The average number of birds on the sections of the Huang He was 1,254.0 (s.d. 477.66) and on the Sungari 353.2 (s.d. 228.52); differences were statistically significant (Mann-Whitney test, $z = 2.61$, $p = 0.009$, $n = 10$). The density of particular species also differed significantly between the two rivers (Wilcoxon test, $z = 3.44$, $p < 0.001$, $n = 70$), a finding supported by the very low Sørensen index, only 6.1%. Differences were also observed in the average flock sizes of some species (Wilcoxon test, $z = 3.51$, $p < 0.001$, $n = 70$), flocks generally being bigger on the Huang He (Table 1).

Discussion

A comparison of the incidence of birds on both rivers indicated a potentially more important role for the Huang He than the Sungari for migrating birds. Admittedly this conclusion is based on a short period of observations on both rivers but it was within the time of intense migration. In addition, observations were conducted on relatively long stretches of both rivers (over 100 km) with various habitats and feeding places favourable for a wide variety of birds. Canoes enabled easy movement and gave us access to sheltered places where the birds concentrated and which it would not have been possible to count from the banks. It also enabled us to assess further the species composition in this part of the migration period.

What are the reasons for the differences between the avifaunas of the two rivers? One factor contributing to the substantially smaller number of birds on the Sungari could be the widths of the rivers. At this time, when backwaters covered large areas, birds used not only islands and sandbars but also areas outside the river channel, where they were more scattered and harder to detect. Second, high water levels limited the number of places available for feeding and resting, particularly on the Sungari. Third, the geographical location of the Huang He, more southerly than the Sungari and where additional species such as Eurasian Spoonbill were found, could also contribute to the differences between the rivers. However, probably the most important factor—leading to both the high diversity of species and the numbers of birds—is the path of the main migration route from north-east Asia to the wintering areas in South-East Asia and Australia, running along the coast of the Sea of Okhotsk, the Sea of Japan and the shore of the Yellow Sea (Parish *et al.* 1987, Pronkevich 1998, Barter *et al.* 2001, Zhang *et al.* 2010), thus by-passing the Sungari valley. Despite this, for species such as White-winged Tern, the Sungari is more important (based on the intensity of migration) than the Huang He. It is also possible that the intensity of migration may be different at other times.

Despite our short study period, the number of birds of four species exceeded 1% of the total migrating populations of the EAAF (Partnership for the EAAF 2008). On the Sungari it was White-winged Tern (4.1% of EAAF migrating population) and on the Huang He, Eurasian Spoonbill (6.3%), Black-headed Gull (3.0%) and Common Tern (1.5%). This indicates that both rivers play an important role as migration routes in China for some species of waterbirds, but it merits further more detailed and longer observation. As a result of the rapid development of infrastructure and construction of new reservoirs, conditions for migrating birds may soon change significantly; thus such studies are urgent.

Table 1. Details of bird species observed on the Huang He and Sungari rivers. N: numbers of individuals. P: % of total count. D: density (birds /10 km). M: mean size of flock.

	Huang He, 143 km length				Sungari, 126 km length			
Species	**N**	**P**	**D**	**M**	**N**	**P**	**D**	**M**
Ruddy Shelduck *Tadarna ferruginea*	**73**	1.2	5.1	6.6				
Common Shelduck *Tadarna tadarna*	**2**	< 0.1	0.1	2				
Gadwall *Anas strepera*	**147**	2.3	10.3	16.3				
Eurasian Wigeon *Anas penelape*	**3**	< 0.1	0.2	3				
Mallard *Anas platyrhynchas*	**647**	10.3	45.2	20.9	**51**	2.9	4.0	4.3
Eastern Spot-billed Duck *Anas zanaryncha*	**88**	1.4	6.2	8	**55**	3.1	4.4	3.1
Northern Shoveler *Anas clypeata*	**16**	0.3	1.1	8				
Northern Pintail *Anas acuta*	**23**	0.4	1.6	5.8				
Garganey *Anas querquedula*					**8**	0.5	0.6	8
Common Teal *Anas crecca*	**194**	3.1	13.6	21.6				
Red-crested Pochard *Netta rufina*	**13**	0.2	0.9	4.3				
Common Pochard *Aythya ferina*	**2**	< 0.1	0.1	2				
Ferruginous Pochard *Aythya nyraca*	**6**	0.1	0.4	6				
Tufted Duck *Aythya fuligula*	**3**	< 0.1	0.2	3				
Black Stork *Cicania nigra*	**17**	0.3	1.2	2.8				
Eurasian Spoonbill *Platalea leucaradia*	**616**	9.8	43.1	9.6				
Black-crowned Night Heron *Nycticarax nycticarax*	**1**	< 0.1	0.1	1				
Striated Heron *Butarides striata*					**7**	0.4	0.6	1.4
Chinese Pond Heron *Ardeala bacchus*					**7**	0.4	0.6	1.2
Grey Heron *Ardea cinerea*	**212**	3.4	14.8	3.7	**55**	3.1	4.4	2.1
Purple Heron *Ardea purpurea*	**1**	< 0.1	0.1	1	**3**	0.2	0.2	1.5
Great Egret *Casmeradius albus*	**36**	0.6	2.5	1.6				
Great Cormorant *Phalacracarax carba*	**4**	0.1	0.3	1				
Common Moorhen *Gallinula chlarapus*	**1**	< 0.1	0.1	1	**2**	0.1	0.2	1
Eurasian Oystercatcher *Haematapus astralegus*					**1**	<0.1	0.1	1
Black-winged Stilt *Himantapus himantapus*	**55**	0.9	3.8	3.2	**11**	0.6	0.9	2.8
Pied Avocet *Recurvirastra avasetta*	**79**	1.3	5.5	26.3				
Northern Lapwing *Vanellus vanellus*	**27**	0.4	1.9	5.4				
Grey-headed Lapwing *Vanellus cinereus*	**117**	1.9	8.2	4.9	**8**	0.5	0.6	1.3
Pacific Golden Plover *Pluvialis fulva*	**8**	0.1	0.6	4				
Grey Plover *Pluvialis squatarala*					**2**	0.1	0.2	1
Long-billed Plover *Charadrius placidus*					**15**	0.8	1.2	1.7
Little Ringed Plover *Charadrius dubius*	**9**	0.1	0.6	2.3				
Kentish Plover *Charadrius alexandrinus*	**31**	0.5	2.2	2.8				
Lesser Sand Plover *Charadrius mangalus*					**2**	0.1	0.2	2
Oriental Plover *Charadius veredus*	**11**	0.2	0.8	11				
Common Snipe *Gallinaga gallinaga*	**1**	< 0.1	0.1	1	**2**	0.1	0.2	2
Black-tailed Godwit *Limasa limasa*	**19**	0.3	1.3	6.3				
Bar-tailed Godwit *Limasa lappanica*					**19**	1.1	1.5	19
Whimbrel *Numenius phaeapus*					**1**	<0.1	0.1	1
Eurasian Curlew *Numenius arquata*	**8**	0.1	0.6	1.3	**5**	0.3	0.4	2.5
Spotted Redshank *Tringa erythrapus*	**30**	0.5	2.1	15				
Common Redshank *Tringa tatanus*	**2**	< 0.1	0.1	1				
Common Greenshank *Tringa nebularia*	**48**	0.8	3.4	1.2	**43**	2.4	3.4	1.4
Green Sandpiper *Tringa achrapus*	**9**	0.1	0.6	1.8	**21**	1.2	1.7	1.4
Wood Sandpiper *Tringa glareala*	**26**	0.4	1.8	2.6	**17**	1	1.3	1.7
Terek Sandpiper *Xenus cinereus*					**5**	0.3	0.4	1.7
Common Sandpiper *Actitis hypaleucas*	**47**	0.7	3.3	2	**66**	3.7	4.9	1.3
Ruddy Turnstone *Arenaria interpres*	**4**	0.1	0.3	2	**7**	0.4	0.6	3.5
Sanderling *Calidris alba*					**1**	0.1	0.1	1
Red-necked Stint *Calidris ruficallis*					**3**	0.2	0.2	3
Temminck's Stint *Calidris temminckii*	**9**	0.1	0.6	1.8	**1**	<0.1	0.1	1

Species	Huang He, 143 km length				Sungari, 126 km length			
	N	P	D	M	N	P	D	M
Long-toed Stint *Calidris subminuta*					**1**	<0.1	0.1	1
Dunlin *Calidris alpina*	**10**	0.2	0.7	10				
Curlew Sandpiper *Calidris ferruginea*	**6**	0.1	0.4	3				
Red-necked Phalarope *Phalarapus labatus*					**1**	<0.1	0.1	1
Oriental Pratincole *Glareola maldivarum*	**150**	2.4	10.5	150				
Mew Gull *Larus canus*	**1**	< 0.1	0.1	1				
Caspian Gull *Larus cachinnans*	**11**	0.2	0.8	2.2				
Pallas's Gull *Larus ichthyaetus*	**19**	0.3	1.3	2.1				
Black-headed Gull *Larus ridibundus*	**2,932**	46.8	205.0	55.3	**70**	4.0	5.6	5
Relict Gull *Larus relictus*	**2**	< 0.1	0.1	2				
Gull-billed Tern *Sterna nilatica*	**9**	0.1	0.6	1.3				
Caspian Tern *Sterna caspia*	**7**	0.1	0.5	7				
Common Tern *Sterna hirunda*	**366**	5.8	25.6	7.5	**13**	0.7	1.0	1.9
Little Tern *Sterna albifrans*	**22**	0.4	1.5	1.8	**3**	0.2	0.2	1.5
Whiskered Tern *Chlidanias hybridus*	**22**	0.4	1.5	3.7	**209**	11.8	16.6	8.4
White-winged Tern *Chlidanias leucapterus*	**68**	1.1	4.8	7.6	**1,034**	58.6	82.1	39.8
Common Kingfisher *Alceda atthis*					**15**	0.8	1.2	1.2
Crested Kingfisher *Megaceryle lugubris*					**3**	0.2	0.2	3
Total	**6,270**	100	438.4		**1,767**	100	140.2	

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